We Claim:

1. An ordered, single domain nanopore array having a macroscale area located in a first material, wherein the first material comprises a metal oxide film formed by anodic oxidation of a metal film or a non metal oxide material in which the nanopore array is formed using a metal oxide nanopore array template.

2. The array of claim 1, wherein the first material comprises a metal oxide film formed by anodic oxidation of a metal film

3. The array of claim 1, wherein the first material comprises a semiconductor material.

4. The array of claim 1, wherein the array is substantially defect free in the single domain.

5. The array of claim 4, wherein the single domain nanopore array comprises nanopores arranged in a predetermined ordered symmetric pattern.

6. The array of claim 5, wherein the single domain nanopore array comprises nanopores arranged in an ordered square or triangular symmetric pattern.

7. The array of claim 4, wherein the single domain nanopore array comprises nanopores arranged in a one dimensional grating pattern where the nanopores are aligned in order along a grating vector direction but are not aligned along a grating line direction.

8. The array of claim 4, wherein the single domain nanopore array comprises a plurality of cells, each cell comprising nanopores arranged in a predetermined ordered symmetric pattern.

9. The array of claim 1, wherein the macroscale area comprises an area of at least one centimeter.

10. The array of claim 2, wherein the metal oxide film is located over a patterned substrate having an ordered pattern of depressions located in correspondence with an ordered pattern of nanopores in the metal oxide film.

11. The array of claim 1, wherein the nanopore diameter is 500 nm or less.

12. The array of claim 11, wherein the nanopore diameter is about 5-10 nm.

13. The array of claim 1, wherein the nanopores are filled with a second material different from the first material.

14. A device comprising a nanopore array having an ordered predetermined pattern of nanopores in a first layer of the device.

15. The device of claim 14, wherein the device comprises a photonic crystal comprising an optically transmissive layer and the nanopore array located in the optically transmissive layer, such that an optical path is formed in predetermined nanopore free areas of the optically transmissive layer that are bounded by the nanopores of the nanopore array.

16. The device of claim 14, wherein the device comprises an electronic device.

17. The device of claim 16, wherein the device comprises a memory device comprising an array of capacitors, wherein the capacitors comprise a capacitor dielectric or a capacitor ferroelectric material located in the pores of the first layer and capacitor electrodes located on either side of the first layer.

18. The device of claim 16, wherein the electronic device comprises a programmable array device comprising an array of fusible links or an antifuse dielectric located in the pores in the first layer and electrodes located on either side of the first layer.

19. The device of claim 14, wherein the device comprises a radiation emitting or detecting device comprising a radiation emitting or radiation sensitive material located in the pores of the first layer.

20. The device of claim 14, wherein the device is selected from at least one of a magnetic sensor comprising a magnetic material located in the pores in the first layer, a fuel cell storage media, a display device comprising carbon nanotubes located in the pores in the first layer, a chemical catalyst, a battery comprising electrodes located in the pores of the first material and a nanoporous membrane.

21. The device of claim 14, wherein the nanopore array comprises a single domain nanopore array containing

nanopores arranged in a predetermined ordered symmetric pattern in a macroscale area and the nanopores are filled with a second material different from a material of the first layer.

22. A method of making a nanopore array with a controlled first pattern, comprising:

providing a substrate comprising a first surface having a first pattern;

depositing a first material capable of forming nanopores onto said first surface having the first pattern; and

anodically oxidizing said first material to form the nanopore array with the controlled first pattern in the anodically oxidized first material.

23. The method of claim 22, further comprising:

forming a photoresist layer on the first surface;

patterning the photoresist layer to form a patterned photoresist layer; and

etching the first surface using the photoresist layer as a mask to form the first pattern in the first surface.

24. The method of claim 23, wherein the step of patterning the photoresist layer comprises holographically exposing the photoresist layer and selectively removing portions of the photoresist layer after the exposing step to form a controlled photoresist pattern.

25. The method of claim 24, wherein the step of holographically exposing comprises holographically exposing

the photoresist layer a plurality of times while rotating the substrate and the exposing beam relative to each other between exposures to form a controlled three dimensional pattern in the photoresist layer.

26. The method of claim 23, wherein the first material contains first depressions which correspond to second depressions in the first pattern in the first surface of the substrate and the nanopores are selectively formed in the first depressions.

27. The method of claim 23, wherein the first material comprises an anodically anodizable metal.

28. The method of claim 22, further comprising etching the substrate using the anodically oxidized first material as a mask to form a nanopore array in the substrate and removing the anodically oxidized first material after the step of etching the substrate.

29. The method of claim 28, further comprising filling the nanopores in the substrate with a second material to form a device.

30. The method of claim 29, wherein the second material comprises a metal interconnect which contacts a solid state device on the substrate or a lower level of a solid state device metallization.

31. The method of claim 22, further comprising filling the nanopores with a second material to form a device.

32. The method of claim 22, wherein the step of filling comprises selectively filling the nanopores with a metal by electroplating.

33. The method of claim 32, further comprises selectively vapor depositing a material on the metal located in the nanopores.

34. The method of claim 22, further comprising anodically anodizing the first material a plurality of times under different conditions to form a plurality of separated cells, each cell comprising nanopores arranged in a predetermined ordered symmetric pattern.

35. The method of claim 22, further comprising:

placing a conformal template material into the nanopores, such that the template material comprises a plurality of ridges which extend into the nanopores; and

removing the template material containing the ridges from the nanopores.

36. The method of claim 22, wherein:

the step of providing a substrate comprising a first surface having a first pattern comprises forming a first photoresist pattern on the substrate; and

the step of depositing the first material comprises depositing a metal film onto the first photoresist pattern.

37. The method of claim 22, wherein the step of providing a substrate comprising a first surface having a first pattern comprises:

forming a hardmask layer over the substrate;

forming a two dimensional photoresist pattern on the hardmask layer;

forming a hardmask by etching the hardmask layer using the photoresist pattern as a mask; and

forming the first pattern by etching the substrate using the hardmask as a mask.

38. The method of claim 22, wherein the step of providing a substrate comprising a first surface having a first pattern comprises:

forming a hardmask layer over the substrate;

forming a first one dimensional photoresist pattern having grating lines extending in a first direction on the hardmask layer;

etching the hardmask layer using the first photoresist pattern as a mask;

removing the first photoresist pattern;

forming a second one dimensional photoresist pattern having grating lines extending in a second direction different from the first direction on the hardmask layer;

forming a hardmask by etching the hardmask layer using the second photoresist pattern as a mask;

removing the second photoresist pattern; and

forming the first pattern by etching the substrate using the hardmask as a mask.

39. A method of making a nanopore arrays with a controlled pattern, comprising:

providing a metal film capable of forming nanopores;

photolithographically patterning a first surface of the metal film to form a controlled pattern of depressions in a first surface of the metal film; and

anodically oxidizing said metal film to selectively form the nanopores in the depressions in the anodically oxidized metal film.

40. The method of claim 39, further comprising:

forming a photoresist layer on the first surface of the metal film;

patterning the photoresist layer to form a patterned photoresist layer; and

etching the first surface of the metal film using the photoresist layer as a mask to form the first pattern in the first surface of the metal film.

41. The method of claim 40, wherein the step of patterning the photoresist layer comprises holographically exposing the photoresist layer and selectively removing portions of the photoresist layer after the exposing step to form a controlled photoresist pattern.